R E P O R T R E S U M E S

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DEVELOPMENTAL PREPARATORY STUDY OF THE INTRODUCTION OF NEW SCIENCE CURRICULAR MATERIALS AND PROCEDURES INTO THE ELEMENTARY GRADES OF TWO RELATED SCHOOL DISTRICTS - HANOVER, NEW HAMPSHIRE SUPERVISORY UNION NUMBER 22 AND NORWICH, VERMONT SCHOOL DISTRICT.

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DESCRIPTORS- *CURRICULUM, *ELEMENTARY SCHOOL SCIENCE, *INSTRUCTIONAL MATERIALS, *SCIENCE COURSE IMPROVEMENT PROJECT, CURRICULUM PLANNING, CURRICULUM EVALUATION, EDUCATIONAL PROGRAMS, INSERVICE TEACHER EDUCATION,

DEVELOPED WERE THE PLANS AND PROCEDURES NECESSARY TO INTRODUCE A COHERENT SCIENCE PROGRAM INTO THE ELEMENTARY SCHOOLS OF TWO SCHOOL DISTRICTS BY USING UNITS FROM VARIOUS DEVELOPMENTAL CENTERS UNDER NON-EXPERIMENTAL CONDITIONS. EMPLOYING A GENERAL EDUCATION COORDINATOR WHO WORKED WITH TEACHERS HAVING A MINIMUM AMOUNT OF PREPARATION IN THE SCIENCES, THE STUDY SOUGHT TO DISCOVER THOSE MATERIALS DEVELOPED BY SCIENCE STUDY CENTERS WHICH COULD BE READILY ADAPTED TO THE SCHOOL PROGRAM. IT STUDIED THE WORKING ARRANGEMENTS BETWEEN DARTMOUTH COLLEGE AND THE PARTICIPATING SCHOOLS, AND ORGANIZED PRELIMINARY IN-SERVICE TRAINING FOR TEACHERS WHO WOULD BE INTRODUCING THE NEW MATERIALS. THE PRINCIPAL RESULT WAS THE DEVELOPMENT OF A THREE-YEAR CURRICULUM IMPROVEMENT PROPOSAL. THIS PROPOSAL (1) OUTLINED THE REQUISITE PRE-SERVICE AND IN-SERVICE TRAINING NEEDED IN THE DISTRICTS, (2) CALLED FOR FURTHER WORK BY THE COORDINATOR AT THE SCIENCE STUDY CENTERS, (3) PRESENTED A TRY-OUT SCHEDULE IN THE SCHOOLS FOR A THREE-YEAR PERIOD, AND (4) IDENTIFIED PARTICULAR UNITS, GRADE BY GRADE, THAT WOULD MAKE UP THE PROGRAM IN SCIENCE. (DS)

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FINAL REPORT

Project No. 5-8353
Contract No. OE-6-10-296

DEVELOPMENTAL PREPARATORY STUDY OF THE INTRODUCTION OF NEW SCIENCE CURRICULAR MATERIALS AND PROCEDURES INTO THE ELEMENTARY GRADES OF TWO RELATED SCHOOL DISTRICTS: HANOVER, NEW HAMPSHIRE SUPERVISORY UNION #22 AND NORWICH, VERMONT SCHOOL DISTRICT.

April 1968

U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
Bureau of Research

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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DEVELOPMENTAL PREPARATORY STUDY OF THE INTRODUCTION OF NEW SCIENCE CURRICULAR MATERIALS AND PROCEDURES INTO THE ELEMENTARY GRADES OF TWO RELATED SCHOOL DISTRICTS: HANOVER, NEW HAMPSHIRE SUPERVISORY UNION #22 AND NORWICH, VERMONT SCHOOL DISTRICT.

Project No. 5-8353
Contract No. OE-6-10-296

Leonard M. Rieser

April 1968

The research reported herein was performed pursuant to a contract with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

Dartmouth College

Hanover, N. H.

INTRODUCTION

1. Problem on which research was focused:

There has been much recent emphasis on science at the secondary level, resulting in the new programs such as BSCS and PSSC. These have been developed by subject specialists with depth in their fields. No comparable program has been achieved in elementary school sciences, with the result that most students lack adequate preparation for the challenge of secondary school science. The research and findings of the various groups involved have made available a great number and variety of imaginative approaches to elementary science, however. This material, although available, has been introduced and used selectively only in a small number of classrooms.

The development of a coherent science program for the elementary schools may best be served by independent, local decisions in drawing upon units from the various centers of developmental work. In shaping a curriculum for the school systems under consideration we hoped to try materials from many of the developmental programs to determine the effectiveness of various approaches within a highly diversified group of students.

Although most of the new programs in science have been tested in specific classroom conditions as a way to provide guidelines for their modification, many have been developed and tested by specially trained teachers under the surveillance of a subject specialist. They needed to be tested both for teacher assimilation and student impact in regular classroom situations.

There was a need to move these new and uncorrelated approaches to science from the unit try-out step to the applied stage; to place these units in appropriate, effective compilations, in terms of sequence of concepts and maturation levels of students. We began to group the units and materials to ascertain where the gaps and over-lappings exist in terms of developing a logical, coherent program of study. Many units are oriented to fit into a sequential pattern of logically ordered subject matter development; some units are less involved with specific subject matter and are aimed primarily at the development of scientific thinking. These needed to be identified for purposes of comparing their relative contributions in various parts of the science curriculum to achieve flexible programs.

Two related problems were involved in the process of introducing the new science approaches into the classroom. First, experimentation was needed to ascertain how adequately new programs in elementary science can be implemented by a general education coordinator rather than a trained specialist, for in most of the nation's school systems curriculum guidance is carried on by a person with general training. Second, it was necessary to find the most realistic way for the regular classroom teacher, who has had a minimum amount of preparation in the sciences, to introduce the new programs. The questions of the amount, the duration, and the intensity of in-service training for teachers, as well as the kind of work necessary, were involved.

In the context of this Small Contract Proposal, the immediate problem was one of establishing the bases for introducing new science materials into the two local school districts under the sponsorship of the Curriculum Improvement Program of the Office of Education. It was proposed that this developmental work be done during 1965-1966 so that the larger science project could begin in mid-August of 1966. The Curriculum Improvement proposal was turned down by the Office of Education in 1966.

2. Objectives

The fundamental objectives for the preparatory period were:

a. The compilation and organization of the materials produced by the science study centers, such as ESS, AAAS, the Berkeley groups, the astronomy group in Illinois, and the Earth Science Project at Princeton.

b. The organization of the working arrangements vis-a-vis the College, the project administration, the school administration, and the elementary school teachers.

c. The conducting of preliminary in-service training for school teachers who would be introducing the new materials.

3. Related Research

A survey of the literature on science in the elementary school pointed up the need for a project such as we proposed. In contrast with the bulk of writing about secondary school science, the material concerned with elementary school science is slim indeed. The call for broad program planning, K-12, emphasizes the lack of articulation between secondary and elementary school revisions (Glenn O. Blough, "Elementary School Science--Implications for High School," Nat. Ass'n. Sec. Sch. Prin. Bul., 1953; The Shape of Education for 1962-63 by Editors of Education USA).

The concept of what constitutes a suitable elementary school science program is not clear. One study pointed out that only 4 per cent of the topics identified in an analysis of courses of study published during 1940-42 recurred in half of the 163 courses analyzed (Encyclopedia of Educational Research, 1960). Two problems facing the elementary school science teacher, the use of the laboratory and of audio-visual aids, are relatively unexplored (Encyclopedia of Educational Research, 1960). These topics are implicitly included in the study we proposed.

The whole matter of creative inquiry, problem solving, subject matter "structure" and the inductive approach have been introduced generally (Jerome Bruner, The Process of Education, 1961) but need to be dealt with on the functional level. It is significant that the Elementary Science Guide for the State of New Hampshire, published in 1961, refers to the newly developed science programs only indirectly in the bibliography under "Some Selected Science Books for the School Library."

METHOD

1. Personnel

With the initiation of the Small Contract grant, a Planning Administrator was appointed to carry out the objectives of the proposal. Mrs. Barbara Ragle, who was mentioned in the Small Contract Proposal as assisting in this work, was named to this position. In order to give Mrs. Ragle release time from her teaching at the Norwich, Vermont Elementary School, Mrs. Elizabeth Simpson was hired as a part-time replacement teacher. Since Mrs. Simpson was inexperienced as a teacher and was, therefore, working under Mrs. Ragle's supervision, this situation served as an introduction to identifying some of the assets and disadvantages of specific new science units for use by inexperienced teachers. Part-time secretarial help was used to aid the administrator with office work.

2. Facilities

An unused room in the Norwich School was turned over to the Elementary School Science Project and equipped for use as an office. This room served as the center for science equipment used in the four schools. In addition to the basic equipment being distributed from here, there was a central reserve supply so that broken equipment was quickly replaced without undue red tape. One part of the room served as a laboratory-workshop where simple experiments were tried out by teachers and where tools were available to encourage them to construct or modify equipment to meet special needs.

The office also was a living-specimen center where limited numbers of animals and plants were available. These were primarily for teachers to become acquainted with in order to determine their usefulness in their own classrooms, but were also available on loan for short periods. The office kept up-to-date as possible on current changes and phenomena in our natural surroundings to intensify the teachers' awareness of these. Bulletins and field trips supplemented information wherever valuable.

3. Survey of Materials

One of the important objectives of the planning stage was to conduct a comprehensive survey of current practices in elementary school science to identify any areas where innovative approaches were in practice. To aid in this, many letters were sent to the following groups (see Appendix A for letters and responses):

a. Developmental Centers as listed in the Information Clearinghouse at the University of Maryland;
b. State Departments of Education;
c. Publishers of magazines in the field of education;
d. Scientific supply houses;
e. Universities and Colleges in Vermont and New Hampshire.

Initial evaluation of new science materials and units was made through study and discussion in an effort to decide which ones would be most effective in our local system and how the diverse approaches of the different developmental centers could be amalgamated into a reasonable synthesis.

Another part of this survey was to make direct contact with several school districts within a radius of 1,000 miles where starts had been made in introducing new science materials and workshops set up to train teachers for this. (See Appendix B).

Following the initial contact with all the developmental centers, all available publications by them were procured, either through donation or purchase, and means for continued contact were established to keep abreast of new materials as they became available. (See Appendix C).

4. Training of Personnel

Since the Planning Administrator was to be responsible for the conduct of workshops and supervision of all the local science teachers during the school year, it was considered important that she receive all possible training and experience

with the new materials. Therefore, she attended a one-week in-service workshop for supervisors conducted by ESS at Educational Services, Incorporated in May. In July, she attended parts of a two-week in-service workshop conducted by AAAS at the University of Maryland.

To avail ourselves of all possible preliminary training for the teachers, a third-grade classroom teacher from the Hanover, New Hampshire Elementary School was selected to attend the University of Maryland program also.

5. Contact with Local Teachers

During the course of the year, an effort was made to communicate with teachers, not only to clarify for them the objectives of the science project but also to learn more about their needs and their backgrounds in science. One general meeting was held, a questionnaire was answered and many individual contacts were made. An analysis of the Teacher Questionnaire is in Appendix D. In addition to aiding Mrs. Simpson in classroom implementation of the science units, the Administrator worked closely with the sixth-grade science teacher in Hanover, both in sharing equipment and ideas to convert the contentional curriculum to extensive use of units from the Elementary Science Study. In addition, a fourth-grade science teacher in Norwich did trial teaching for ESS on a new unit.

6. Scheduling Study

Much study was made of the most efficient scheduling for introduction of new units and the attendant workshops. Under consideration were a variety of approaches:

a. Complete revision of science curriculum in one primary grade and one intermediate grade each year;
b. Revision of curriculum in two upper grades the first year, two middle grades the second year, and two lower grades the final year.
c. Reversal of the above order, working first with primary grades.
d. Revision of curriculum in one school at a time, at all grade levels.
e. Introduction of new units to one teacher in each grade at a time to promote efficient use of equipment and cut expenditure.
f. Staggered approach of working with all teachers in one grade at a time, spacing the units so that each grade would be introduced to one unit each year.

The proposed schedule for workshops and for the introduction of units into the elementary grades over a three year period is explained in Appendix E.

RESULTS

Beyond the developmental work outlined in the previous section, the specific result of the Small Contracts study was a larger, three-year Curriculum Improvement Proposal, "Introduction of New Science Curricular Materials and Procedures into Grades 1-6 of Two School Districts," which was submitted to the Office of Education on March 1, 1966. This Curriculum Improvement Project was turned down by the Office of Education.

DISCUSSION

Further indirect results of this study took the form of a continued interest and support of the work in the elementary schools of the two districts. During 1966-1967, support for a half-time effort following the lines drawn in the Curriculum Improvement Proposal was made available from Title III funds in New Hampshire. The school districts and Dartmouth College continued their cooperative effort to improve science teaching in the elementary schools. In December, 1967, Dartmouth College was awarded an NSF Cooperative College-School Science grant which will enable this project to do further teacher training in a summer institute and to extend the range of its effect to several communities outside the original school districts during a follow-up academic year program.

CONCLUSIONS AND RECOMMENDATIONS

Several findings from this developmental study remained to be tested further in the period following the Small Contract support. The nature of these assumptions concerned operational decisions requiring further testing. They may be summarized as follows:

1. For the purposes of these two school districts, the core of the elementary science program would be units from ESS. Adaptations of AAAS and other science programs would be used to supplement the ESS units. Permission was obtained from AAAS to use this approach.

2. Continued training for personnel working with elementary teachers at appropriate curriculum developmental centers is mandatory.

3. Additional training for elementary teachers of the two districts in academic science by faculty at Dartmouth College is necessary, probably at a summer institute.

4. Primary (grades 1-3) teachers are more reluctant to participate in elementary school science projects than are those teaching intermediate (4-6) grades. More encouragement and support is needed to convince primary teachers of the need for science study.

5. Increased effort must be given to the promotion of community support for elementary school science, particularly with relation to gaining the confidence of school boards and school administration officials. Both groups should participate in some way during training sessions to acquaint them with specific goals and procedures in science teaching.

SUMMARY

This project aimed at developing the plans and procedures necessary to introduce a coherent science program into the elementary schools of two districts by trying out units from various developmental centers under non-experimental circumstances. Using a general education coordinator working with teachers with a minimum amount of preparation in the sciences, the study sought to discover the appropriate materials produced by the science study centers such as ESS, AAAS, the Berkeley groups, and others which could be readily adapted to the school program. It studied the working arrangements between Dartmouth College and the schools, and organized preliminary in-service training for teachers who would be introducing the new materials.

The principal result was the development of a three-year Curriculum Improvement Proposal incorporating the findings of the Small Contract study. This Proposal outlined the requisite pre-service and in-service training needed in the districts; it called for further work by the coordinator at the science study centers; it presented a try-out schedule for a three-year period; and it identified particular units, grade by grade, that would make up the program in science.

Although the Curriculum Improvement Proposal was not funded, continued work on the schedule it presented has been achieved with Title III support and with an NSF CCSS grant.

OE 6000 (REV. 9-66)

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF EDUCATION

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TITLE

100 Developmental Preparatory Study of the Introduction of New Science
101 Curricular Materials and Procedures into the Elementary Grades of Two Related
102 School Districts: Hanover, New Hampshire Supervisory Union #22 and Norwich,
103 Vermont School District

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APPENDIX A

ELEMENTARY SCHOOL SCIENCE PLANNING PROJECT

NORWICH, VERMONT · TELEPHONE (802) 649 1151

Steering Committee:

Dartmouth College
PROF. WILLIAM W. BALLARD
PROF. DONALD A. CAMPBELL
DEAN LEONARD M. RIESER
PROF. PAUL R. SHAFER

Superintendent
DR. WILLIAM C. ZIMMERMAN, JR.
Planning Administrator
MRS. BARBARA RAGLE

Dear Sir:

Through the sponsorship of Dartmouth College, our two local school systems have just received a grant from the United States Office of Education to study how to introduce effectively the new materials and procedures for teaching science in the elementary grades. Dean Leonard Rieser of Dartmouth is the principal investigator assisted by a steering committee of college professors and school administrators.

We plan to draw upon many of the recently developed science units and ultimately evaluate their use as parts of flexible science curricula. Our districts include schools representing considerable diversity in economic and cultural conditions, so the suitability of units in each situation will vary. Concomitant with this objective will be the opportunity to determine the necessary training for teachers to introduce the new materials into the classroom effectively.

In this preliminary planning stage, we are anxious to assemble as complete a record as possible of the new materials now available. We have heard about your work in this field and wish to further our familiarity with it. We would appreciate it if you could send us copies of your available publications, and add us to your permanent mailing list. Since pre-service and in-service training for teachers is part of our projected program, we will be interested in this aspect of your experience with teachers using your materials.

Although we may start working with small groups of teachers later in the current school year, our major efforts are projected for the three ensuing years. Of course, we will keep you informed of our plans and findings in this project, and also wish to cooperate with you in any ways feasible. We shall look forward to hearing from you concerning the availability of your materials and establishing cooperation in our work.

Sincerely,

Mrs. Barbara Ragle

APPENDIX A

ELEMENTARY SCHOOL SCIENCE PLANNING PROJECT

NORWICH, VERMONT · TELEPHONE (802) 649-1131

Steering Committee:

Dartmouth College
PROF. WILLIAM W. BALLARD
PROF. DONALD A. CAMPBELL
DEAN LEONARD M. RIESER
PROF. PAUL R. SHAFER

Superintendent
DR. WILLIAM G. ZIMMERMAN, JR.
Planning Administrator
MRS. BARBARA RAGLE

Gentlemen:

Through the sponsorship of Dartmouth College, our two local school districts have just received a grant from the United States Office of Education to make a three-year study of how to introduce effectively the new materials and procedures for teaching elementary school science into a whole school system. Our ultimate aim is to involve students in grades 1-6 in scientific processes through inquiry and individual manipulation of materials. Concomitant with this will be the investigation of the kind of training most helpful to teachers to promote this kind of learning in the classroom.

We have been in contact with the major developmental centers such as Elementary Science Study, American Association for Advancement of Science, Elementary School Science Projects of the University of California and the University of Illinois, and Minnemast. We are now assembling materials from them and are searching for any other sources that are primarily concerned with promoting investigation and inductive thinking in children. Possibly, you have been concerned with this same need and have published materials that would be relevant to our project. If so, we would appreciate it if you would send us complimentary copies for our study and consideration.

Thank you for your interest and any help you can give us.

Sincerely,

Mrs. Barbara Ragle

APPENDIX A

ELEMENTARY SCHOOL SCIENCE PLANNING PROJECT

NORWICH, VERMONT · TELEPHONE (802) 649-1151

Steering Committee:

Dartmouth College
PROF. WILLIAM W. BALLARD
PROF. DONALD A. CAMPBELL
DEAN LEONARD M. RIESER
PROF. PAUL R. SHAFER

Superintendent
DR. WILLIAM G. ZIMMERMAN, JR.
Planning Administrator
MRS. BARBARA RAGLE

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We have been in contact with the major developmental centers such as Elementary Science Study, American Association for Advancement of Science, Elementary School Science Projects of the University of California and the University of Illinois, and Minnemast. We are now assembling materials from them and are searching for any other sources that are primarily concerned with promoting investigation and inductive thinking in children.

Possibly, you have been concerned with this same need and are developing equipment with this purpose in mind -- materials that will lend themselves to individual experimentation by students. If so, we would be interested in knowing more about them, and would appreciate any help you can give us in this project.

Sincerely,

Mrs. Barbara Ragle

APPENDIX A

ELEMENTARY SCHOOL SCIENCE PLANNING PROJECT

NORWICH, VERMONT · TELEPHONE (802) 649-1151

Steering Committee:

Dartmouth College
PROF. WILLIAM W. BALLARD
PROF. DONALD A. CAMPBELL
DEAN LEONARD M. RIESER
PROF. PAUL R. SHAFER

Superintendent
DR. WILLIAM G. ZIMMERMAN, JR.
Planning Administrator
MRS. BARBARA RAGLE

January, 1966

Dear

As members of our community who have always been concerned with the activities of our schools, we think you will be interested in learning of a planning grant that our school districts have received from the U. S. Office of Education. This grant comes through the sponsorship of Dartmouth College for the purpose of studying how to effectively introduce the new materials and procedures for teaching science in the elementary grades. Dean Leonard Rieser is the principal investigator and is assisted by a steering committee of professors from the College and school personnel.

Currently, we are assembling the newly developed science materials from such developmental centers as Elementary Science Study in Watertown, Mass.; American Association for the Advancement of Science; Elementary School Science Project of the University of California; Elementary School Science Project of the University of Illinois; and MINNEMAST at the University of Minnesota. All of these groups are concerned with promoting scientific inquiry and investigation by children to develop familiarity with scientific processes and to encourage inductive thinking. Concomitant with the selection of the materials most appropriate for our needs will be the opportunity to determine the kind of training for teachers most helpful in promoting this kind of learning in the classroom.

We feel that our community has unique attributes for this study because of the diversity of interests and occupations it represents, as well as our geographical assets. This "abundance of riches" can contribute significantly to our success, both in the innovations we make here and the investigation of procedures that can be patterned by other school systems.

As pre-service and in-service training commences and classroom projects get under way, there will be much need to draw upon local talent and facilities. We hope in the meantime that any of you who are particularly interested or have ideas to contribute will contact us in our office in the Norwich School.

Sincerely,

(Mrs.) Barbara Ragle

APPENDIX A

SUMMARY OF PUBLISHER'S REPLIES

This form letter was sent to 222 publishers. In response we have received catalogs, textbooks, paperback books, and assorted pamphlets and charts. In general the replies break down as follows:

A. The following companies have sent complimentary copies of <u>textbooks</u> for our study and consideration:

1) Harper & Row, Publishers, Inc., TODAY'S BASIC SCIENCE, Teacher's Ed. for grades 1-6; also manuals, charts, and 6 booklets.

2) Holt, Rinehart & Winston, Inc., SCIENCE, A MODERN APPROACH, Teacher's Ed., for grades 1-6.

3) Scott, Foresman & Co., SCIENCE IS ADVENTURING, Teacher's Ed. for grade 6; also BASIC SCIENCE HANDBOOK, and charts and pamphlets.

4) Silver Burdett & Co., SCIENCE, Teacher's Ed. for grades 1-6 and a teacher's manual.

5) Laidlaw Brothers, SCIENCE, Teacher's Ed. for grades 1-6.

6) Ginn & Co., SCIENCE FOR YOU, Teacher's Ed. for grades 1, 4, 5 and regular textbooks for grades 2, 3; also a chart.

7) D.C. Heath & Co., HEATH SCIENCE SERIES, Teacher's Ed. for grades 1-6.

8) Harcourt, Brace & World, Inc., CONCEPTS IN SCIENCE, Teacher's Ed. and regular textbooks for grades 1-6; also teacher's manuals and charts.

9) Allyn & Bacon, Inc., EXPLORING SCIENCE, Teacher's Ed. for grades 1-6.

10) American Book Co., THINKING AHEAD IN SCIENCE, Teacher's Ed. for grades 1-6; also 6 pamphlets (on animals, electricity, etc.).

B. The following companies have sent other books:

1) Scholastic Book Services
ARROW BOOK OF SCIENCE FACTS
ARROW BOOK OF ANSWERS
ABOUT ATOMS

2) Pocket Books, Inc.
THE CHEMICAL ELEMENTS
SCIENCE PROJECTS HANDBOOK
ROCKET MANUAL FOR AMATEURS

3) Stock-Vaughn Co., Catalog, and SCIENCE SERIES, Teacher's Ed. of 6 large paperbacks.

4) National Aerospace Education Council, numerous booklets and papers on space and flying.

5) Little, Brown & Co.
EXPERIMENTS FOR YOUNG SCIENTISTS
HOW TO EXPLORE THE SECRET WORLDS OF NATURE
GALILEO AND THE MAGIC NUMBERS
WHAT MAKES A CAR GO?

6) **Sterling Publishing Co.** LEARNING SCIENCE THROUGH COOKING
SCIENCE GAMES FOR CHILDREN
SCIENCE FOR CHILDREN
CHEMISTRY FOR CHILDREN

7) **Sentinel Books, Publishers, Inc., paperbacks:**
HOW TO DISSECT
EXPERIMENTAL BIOLOGY
DISCOVER THE STARS
HUNTING WITH THE MICROSCOPE
LET'S EXPLORE CHEMISTRY
LET'S EXPLORE WITH THE ELECTRON

8) **Bantam Books, paperbacks:** THE SCIENCE OF LIFE
A PLANET CALLED EARTH
A STAR CALLED THE SUN
THE ATOM AND BEYOND
THE NATURAL WORLD
150 SCIENCE EXPERIMENTS STEP-BY-STEP

9) UNESCO SOURCE BOOK FOR SCIENCE TEACHING

We have received about 30 catalogs of which perhaps half are relevant to our needs.

We have orders pending for three books.

We have received 17 replies from publishers with whom there has been no further correspondence, mainly because they had no pertinent material to send. However, several of these letters expressed interest in our project.

Many publishers indicated special interest in our project and mentioned the need for a project such as this one.

APPENDIX A

SUMMARY OF REPLIES FROM STATE DEPARTMENTS OF EDUCATION

This form letter was sent to all fifty U.S. State Departments of Education. We received approximately 42 replies from 35 different states. Many of the form letters had been forwarded to interested individuals and colleges. The replies break down as follows:

15 - sent materials

13 - described programs in their states (the descriptions ranged from extensive to a brief mention)

21 - very interested, keep informed

8 - milder interest

2 - negative reaction

2 - mentioned visiting

(Those who are interested and those who either sent materials or described programs overlap, of course.)

APPENDIX A

SUMMARY OF REPLIES FROM MAGAZINES

A modification for form letter #3 (to publications) was sent to 18 magazines, both professional and children's science magazines, requesting complimentary copies and/or reprints of pertinent material. The following is a breakdown of the requests and responses:

1. Letters requesting complimentary copies and reprints of pertinent material were sent to:

   School Science and Mathematics*
   Journal of Research in Science Teaching*
   Science Digest*
   Science Education
   Education Digest
   Grade Teacher*
   Education Age*
   Nature and Science* (reprints only - of Resource Study Units)

2. Letters requesting only pertinent material from other issues were sent to:

   Scientific American
   Science
   The Instructor*

3. Letters requesting only complimentary copies were sent to:

   Audubon Magazine
   Cornell Science Leaflets*
   Current Science and Aviation*
   Science Newsletter* (for children)
   Space Science
   My Weekly Reader* (for children)
   Science World* (for children)

4. Paid subscriptions to:

   Sky and Telescope*
   The Science Teacher (and) Science and Children* (for children)

*Copies of these have been and are being received.

APPENDIX A

REPLIES FROM SCIENTIFIC SUPPLY HOUSES

This form letter (#4) was sent to 24 Scientific Supply Houses. So far 13 supply houses have answered, most of them with several different catalogs. Two firms were very interested in the project, and one, the Macalaster Scientific Corporation, mentioned that a visit to their factory in Nashua might be informative.

APPENDIX B

SUMMARY OF TRIP TO VISIT OTHER SCHOOL SYSTEMS

During the week of February 14, 1966, the Planning Administrator visited several schools and systems to learn about the experience of others in introducing new science materials.

Science Director William Scheld of Westport, Conn. was visited first. They have introduced several ESS units, with the teachers prepared for each one through a workshop lasting about 8 weeks. Workshops precede the teaching by 2 weeks and then run concurrently, once a week in the afternoons. Teachers are expected to work with the materials and investigate problems themselves as the key to their guiding children to this approach. Mr. Scheld is now preparing a core course to prepare teachers in the general methods of new science methods, which will subsequently be extended by courses in specific materials for particular units. He has no regular schedule for classroom visitation but lets individual needs of teachers determine the schedule, ranging from daily to occasional visits. Mr. Scheld is a person of considerable experience in this field and understands the depth of learning experiences necessary to implement new materials effectively; it was a worthwhile contact.

In Norwalk, Conn. the Director of Science, Mr. Norman Nathanson, was visited. Here the pattern for inquiry approach in teaching was set in 1963 by the Behavioral Outcomes Program, and now ESS and Illinois Astronomy units are being introduced. However, the workshop and follow-up procedures are less clearly delineated and the implementation appears to be less effective than in Westport.

The Fairfield, Conn. school system was visited, where the science program is enthusiastically guided by Mrs. Katie Nespojohn. However, they have not made use of new science materials from the developmental centers and the workshop program is spasmodic, so there was little direct applicability to our project.

In Philadelphia the Rudolph Walton School was visited where, under the guidance of Mrs. Margaret Ephraemson, the AAAS Process Approach is in its third year. Six classes were visited during the day, giving an opportunity to observe some very active teaching and responsive classes. Introduction of the AAAS program started in Grades K, 2, and 2 with one teacher at each grade level, then extended up to include about 12 teachers the second year, and presently there are 15. In the afternoon a semi-monthly workshop was held for all the teachers using AAAS materials; the instructional part of the program was conducted by Mr. James DeRose and dealt with guiding teachers to understanding an "operational definition" as part of scientific process. Mrs. Ephraemson discussed specific teaching problems and classroom procedure. Teachers make regular written evaluations of the materials as part of their training.

At the University of Maryland, Dr. David Lockhard of the Science Materials Center was visited and he set up a schedule for visiting science programs in Montgomery County. Several ESS units are being introduced throughout the county -- Kitchen Physics in 6th grade, Small Things in 5th, Melting Ice Cubes in 4th, and Attribute Blocks in Primary. Workshops are conducted by Mr. James Lathim, who has had some training at ESS. They vary in length from one to eight afternoon sessions depending on the background required for each unit. One workshop lasting 1-3/4 hours was visited where 4th grade teachers were having the second out of three sessions with ice cubes. Teachers were using the equipment and the follow-up discussion was open-ended. A well organized system for distribution of materials has been set up and this is considered an important aid to teachers. The only classroom follow-up to the workshop program is a survey being conducted by trained research observers who make frequent quick evaluations of 100 classrooms. Possible changes in conditions are being noted before, during and after the workshop training. Only one-fourth

of Montgomery County is receiving this cursory introduction to new science methods -- the whole exposure is projected for a three-year period. The immensity of their numbers demands a rapid exposure and there seems to be little opportunity now for the type of follow-up that innovates change in methodology.

An interview with Mr. Robert Nicodemus, who will direct a summer workshop in Montgomery County, was held. The approach will be threefold: 1. Introduction to two specific units -- Small Things and Kitchen Physics -- with teachers handling equipment and receiving background instruction in content. 2. Overview of materials from other developmental centers. 3. Philosophy of inquiry approach.

Mr. Edward Hoffmaster, Director of Science for Montgomery County, explained the development and progress of the science program in Montgomery County and the research they are doing for ESS on the effectiveness of their workshop system.

APPENDIX C: Full Description of Materials

Official contact was made with the major developmental centers through letters explaining our goals. We received all available published materials from those indicated and their current progress reports through newsletters.

American Association for the Advancement of Science (AAAS)
Dr. John Mayor, Commission on Science Education
1515 Massachusetts Avenue, Washington, D. C.
Materials received:
Science -- A Process Approach
Parts I through VII
Integrated Processes
Teachers' Commentary
Competency Measures

Elementary Science Study
Dr. Charles Walcott
108 Water Street
Watertown, Massachusetts
Materials received:
Inspection carton with sample equipment:
Growing Seeds
Kitchen Physics
Gases and Airs
Small Things
Mealworms
Supplementary materials:
Bones (for trial use in Spring 1966 in one of district schools)
Light and Shadows
Mirror Cards

MINNEMAST -- Minnesota School Mathematics and Science Teaching Project
Dr. Gerald Rising, University of Minnesota, Minneapolis, Minn.
Materials received:
Objects and Their Properties
Changing and Unchanging Properties
Introduction to Measurement
Time -- Measurement of Duration
Describing and Classifying
Watching and Wondering
Our Senses
Shape and Symmetry
Math Program I - XX

Science Curriculum Improvement Study (SCIS)
Professor Robert Karplus, Department of Physics
University of California, Berkeley, California
Materials received:
Objects Grab Bag
Meet Mr. O.
Using a Bathroom Scale

Elementary School Science Project
Professor Herbert Mason, Department of Botany
University of California, Berkeley, California
Materials received:
Coordinates -- Parts I - IV
What Am I? -- Unit on Human Physiology

Elementary School Science Project
Professor J. Myron Atkin, College of Education
University of Illinois, Urbana, Illinois
Materials received:
Charting the Universe I
Universe in Motion II
Gravitation III
Message of Starlight IV
Galaxies and The Universe VI

WIMSA -- Webster Institute of Mathematics, Science and the Arts
Mr. Paul Merrick
Webster College, St. Louis, Missouri
Materials received:
The Shell Game

Elementary School Science Project
Dr. John Wood
Utah State University, Logan, Utah
Descriptive reprints received
Curriculum materials on order

Selection of Materials

Among the variety of materials now available, the following were selected for definite use in the first year. Many others are still being evaluated, as will newly developed materials when they become available. The units listed below have been selected for inclusion in the curriculum, either as part of the core program or as extensions thereof.

Grades 1 and 2
Lights and Shadows -- ESS -- Core Program, Year I
Attribute Blocks -- ESS
Growing Seeds -- ESS -- Core Program
Mr. O -- SCIS -- Core Program
Objects Grab Bag -- SCIS
Using a Bathroom Scale -- SCIS
Parts of AAAS Process Approach
I - III
Particularly: Classification, Observation and Observing Processes
Playground Physics Equipment -- ESS
Introduction to Measurement -- MINNEMAST
Shape and Symmetry -- MINNEMAST

Grades 3 and 4
Butterflies -- ESS -- Core Program, Year I, pending publication
The Shell Game -- WIMSA
AAAS -- Process Approach IV and V -- Core Program
Bones -- ESS

Grades 5 and 6
Kitchen Physics -- ESS -- Core Program, Year I
Small Things -- ESS -- Core Program
Microgardening -- ESS
Gases and Airs -- ESS
Mealworms -- ESS
Selections of Charting the Universe, I -- Illinois
Selections of Universe in Motion, II
Selections of AAAS Process Approach, VI and VII

APPENDIX D

ELEMENTARY SCHOOL SCIENCE PLANNING PROJECT

TEACHER QUESTIONNAIRE

Summary of Results

A. General:

Name _____
last first

School _____

Grade or Subjects _____

29 Self-contained classroom
7 Departmentalized

How long have you been teaching? _____

How long in present position? _____

	Primary	Departmentali
Hanover	16	4
Norwich	6	3
Lyme	3	(2)
Orford	2	(2)

( ) Grade 4 not departmenta

B. Science Background:

1. College a/o University courses in Science? (Please give subject or title of course and approximate date taken.)

Primary

3 - no courses
13 - 1 or 2 courses
13 - 3 to 5 courses

Departmentalized

4 - 1 course
1 - 2 courses
4 - 3 "
4 - 4 "
4 - 5 or more

2. Workshop or Institute courses in science?

Primary

7 had taken 1 course

Departmentalized

10 - 0 courses
4 - 1 course
2 - 2-3 courses
1 - 9+ credit hours in workshop

3. Independent study or experiences which have contributed to your science background?

Primary

7-mentioned additional but diverse types of background

Departmentalized

11-mentioned none
6 - T.V., independent study, contact with Dartmout professors, running a ho etc.

4. Hobbies or particular interests related to science?

Primary

11 mentioned hobbies, mostly gardening and cooking

Departmentalized

10 - gardening, ornithology, rock cooking, etc.

7 - no comment

5. Membership in clubs or conservation groups related to science?

Primary

3 mentioned clubs, like conservation group

Departmentalized

1 - National Council of Math Teachers

15 - no comment

6. Magazines to which you subscribe or read fairly regularly that deal primarily with science?

Primary

23 - read none under this category

6 - read 1-6 magazines

Departmentalized

6 - Natural History, Nat'l Geo N.H. Conservationist, ES newsletter, AAAS news nature and Science

11 - none

7. Use of scientific facilities at Dartmouth College or other local organizations to further your own interests or science teaching?

Primary

5 mentioned visiting museum or library

Departmentalized

4 - Films, museum, library Observatory

13 - none

C. Present science teaching:

1. Approximately how much time per week do you presently spend teaching science?

Primary: 5 - indefinite; 8 - 1 hour; 1 - more than 2 hrs.; 4 - 20-45 min.; 11 - 1½-2 hrs.

Departmentalized: 1 - 5 hrs.; 5 - 10+

2. If you teach in a self-contained classroom, please answer the following: 1 - 30

a. Do you plan more time than you actually spend for science but find it gets squeezed out?

9 - "no", 15 - "yes", 6 - "not sure"

b. Do you allot specific time each day or week for science and usually achieve it?

9 - "no", 13 - "yes", 7 - "not sure"

c. Do you work on a unit at a time, then drop science to work on something else?

11 - "no", 9 - "yes", 5 - "don't know"

d. Please rate your pleasure and interest in teaching the following subjects (1) great; (2) moderate; (3) least:

		Primary
___ Reading	___ Social Studies	7 - Science, 1st choi
___ Arithemetic	___ Art	15 - " 2nd "
___ Music	___ Science	4 - " 3rd "
___ Language Arts	___ Other (Specify) _____	2 - did not answer

3. Which of the following do you depend upon most in planning your science teaching?

Primary		Departmentalized
7	State Curriculum Guide _____	0
18	Textbook (please name) _____	3
6	Your own experience in a college course	1
11	Specify other _____ (experiences like nature walks)	6 other texts an sources, schoo curriculum

4. Generally speaking, has there been sufficient equipment for your science projects? Please comment.

Primary	Departmentalized
17 - no	3 - no
9 - yes	3 - yes
3 - ?	
"not enough to do kinds of things we'd like"	

5. If you have ever used any of "the new" science materials (ESS, AAAS, Minnemast, Illinois, etc), please specify:

Primary		Departmentalized
	0 - "yes"	0 - no
	13 - no	2 - ESS
	17 - no comment	1 - ESS & Illino

Comments on your reactions:

6. If you do any science experiments in the classroom, do you usually do them as demonstrations? To what extent, if at all, do the students handle equipment individually?

Primary		Departmentalized
Demonstrations	children individ. involved	6 - demonstrate, but chil also handle equipme
11 - yes	20 - yes	others - "insufficient
13 - no	4 - no	equipment, too
6 - no comment	6 - no comment	hazardous, dem strations neces

7. Please comment on your attitude toward teaching science: security or lack of it in subject matter; interest or lack of it in science as a medium for developing learning power, etc.

Primary

20 - Lack security - time, interest, background
6 - realize importance - enjoy it & interested
3 - not as essential as other subjects
1 - would like good primary text

Departmentalized

" lack of background
" Importance of developing 'Scien attitude'"
General interest an enthusiasm.

D. Professional Interest in Science Project

1. If there is an opportunity to participate in pilot projects in the spring of 1966, would you be anxious or willing to be considered? Would you prefer to wait until the ensuing school year? Please comment.

Primary

19 - yes
6 - no
5 - no comment

Departmentalized

8 - yes
2 - maybe
1 - no

2. Please comment on your interest in participating in science education courses during the summer of 1966 at Dartmouth College on a grant-in-aid basis.

Primary

12 - yes
12 - no
5 - no comment

Departmentalized

8 - yes
2 - maybe
1 - no

3. Please comment on your interest in In-Service training in science education during 1966-1967.

Primary

17 - yes
7 - no
5 - no comment

Departmentalized

8 - yes

4. Which of the above arrangements for course work - Pre-Service or In-Service - would be most satisfactory to you?

Primary

16 - In-Service
4 - Pre-service
7 - no comment
2 - neither

Departmentalized

8 - In-service
2 - Pre-service
6 - no comment
1 - both

Note: The fact that these figures do not total 7 (departmentalized science teach indicates interest from them in other f

E. Present science materials and equipment in your classroom. It would be helpful for us to have a general idea of the equipment in your classroom. This is not a detailed inventory.

1. Please note any equipment you have such as hand lenses, balances, microscopes, aquaria, test tubes, beakers, etc. and anything else you have used or think would contribute to the science program.

Primary

5 - no equipment
8 - central store enough
5 - "limited"
2 - balances and microscopes
4 - no comment

Departmentalized

6 - most of that listed, plus much more

1 - insufficient

2. What other aids to teaching science such as pamphlets, audio-visual aids, resource persons, field trips, etc. have you used?

Primary

12 - parents, doctors, magazines, newspapers, books, library, posters, etc.

18 - audio-visual

15 - field trips

2 - team Teaching

1 - nothing

8 - no comment

Departmentalized

7 - many items mentioned - mostly speakers, field trip film strips.

Appendix E: Proposed Schedule

At the end of August, a one-week workshop will be held to expose teachers to the general principles involved in new science methods. This will be open to all 38 teachers and those attending will receive a stipend. The teachers will handle equipment to learn to probe problems as they will subsequently lead children to do, view films which demonstrate successful use of this method, and have an overview of the materials being produced in the developmental centers.

Workshop training for specific units will commence two weeks prior to actual classroom teaching for teachers of Grades III to VI, and one week prior to teaching for Grades I and II. After teaching begins, the workshops will continue, meeting weekly throughout the teaching period. Initial workshops will acquaint the teachers with the equipment and aims of the unit and give them sufficient background in the subject matter for them to feel at ease. The last workshop will be devoted to evaluation through the teachers' estimations of the children's learnings, plus observations of the coordinator.

Workshops will meet weekly on a specified day from 2:00 to 4:30. The teachers involved will have release time from school for one-and-one-fourth to one-and-three-fourths hours, depending on needed travel time. A core of release-time substitutes will be arranged for by the schools and paid by the project; four or five will be needed to release intermediate grade teachers, and eight to nine for the primary teachers.

The coordinator will set up the workshops and either conduct them personally or arrange for specialists as the needs of the teachers and materials demand. Once classroom teaching of the units has begun, the coordinator will be available to help the teachers. During the initial week of a new unit, the beginning days will be staggered so that the coordinator may devote full time to one school at a time to determine the subsequent needs of specific teachers. It is expected that there will be considerable variation in the amount of classroom help and guidance that teachers will want from the coordinator, ranging from a minimum of one visit a week to brief daily counsel. The schedule is sufficiently flexible with a maximum of nine teachers innovating at a time to allow the coordinator to meet the demands of the situation. It is expected that as teachers become more familiar with the new materials, their need for help from the coordinator will decline and by the last week of a unit, they may be operating on their own, thus freeing the coordinator to plan for the next grade unit.

Tentative units for introduction in first year:

Grade VI - Kitchen Physics (ESS)
Grade V - Small Things (ESS)
Grade IV - AAAS Process Approach
Grade III- AAAS Process Approach
Grade II - Growing Seeds (ESS) and Mr. O (SCIS)
Grade I - Light and Shadows (ESS) and Mirror Cards (ESS)

The units for Grades VI and V are ones which are now taught by two of the local teachers. It is felt that using material already tested and with which other teachers have an acquaintance will allow for sufficient concentration by the coordinator on all the elements involved in the introductory period.

The effectiveness of the workshop and classroom follow-up procedures will be

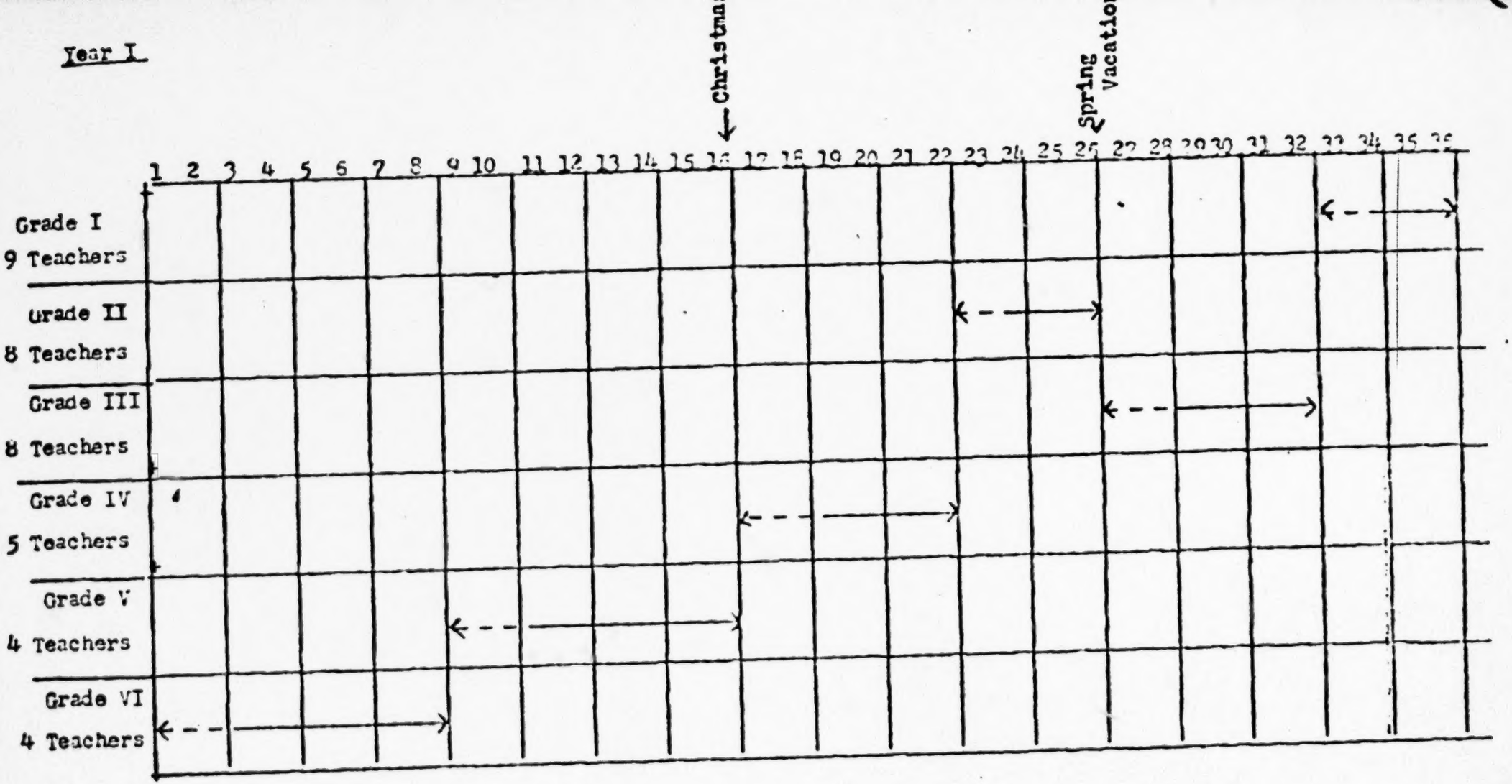
subject to review at the end of the first year. Adjustments can be made in the length or timing of workshops and the frequency of classroom visits in planning for the ensuing year. Tentatively, the basic program of introducing one new unit in each grade will continue in years 2 and 3, implemented by workshops and classroom guidance by the coordinator.

It is anticipated that as teachers gain confidence with the materials, they will extend the scope of the units to which they were introduced the first year. The coordinator's office will play the role of alerting teachers to possible extensions of materials and providing necessary background and equipment to individuals or small groups. In this way, it is hoped that teachers will continue their own feeling for investigation and mold the content of units to their individual interests. For example, Small Things is being introduced to the fifth grade in November and December of the first year. The basic unit can be taught successfully at this time of year and in this length of time. However, the following year, the teacher might teach it in the spring where, after introducing the children to the microscopic world, she would continue to explore pond water and compare cellular structure in different parts of plants. Or, out of the AAAS IV B work with thermometers and temperature the first year, might grow a teacher's interest in setting up weather stations in different "micro-climatic" areas near the school which, in turn, would lead into ecological study of the land.

In addition to extending the core units, it is hoped that teachers in the second and third years will investigate other units from the developmental centers. The facilities of the coordinator's office will be available for selecting materials, procurement of equipment, and help in subject matter content. In order to promote the kind of flexibility and inquiry which is inherent in science, this kind of divergence from the core instruction will be encouraged. Contact with the coordinator will continue sufficiently long to insure that the spirit of inquiry is maintained through new units. The appointment of a teacher-assistant in the second and third years of the program will allow for this expanding flexibility. It will also provide for the special training necessary to bring new teachers in the districts up-to-date with the project.

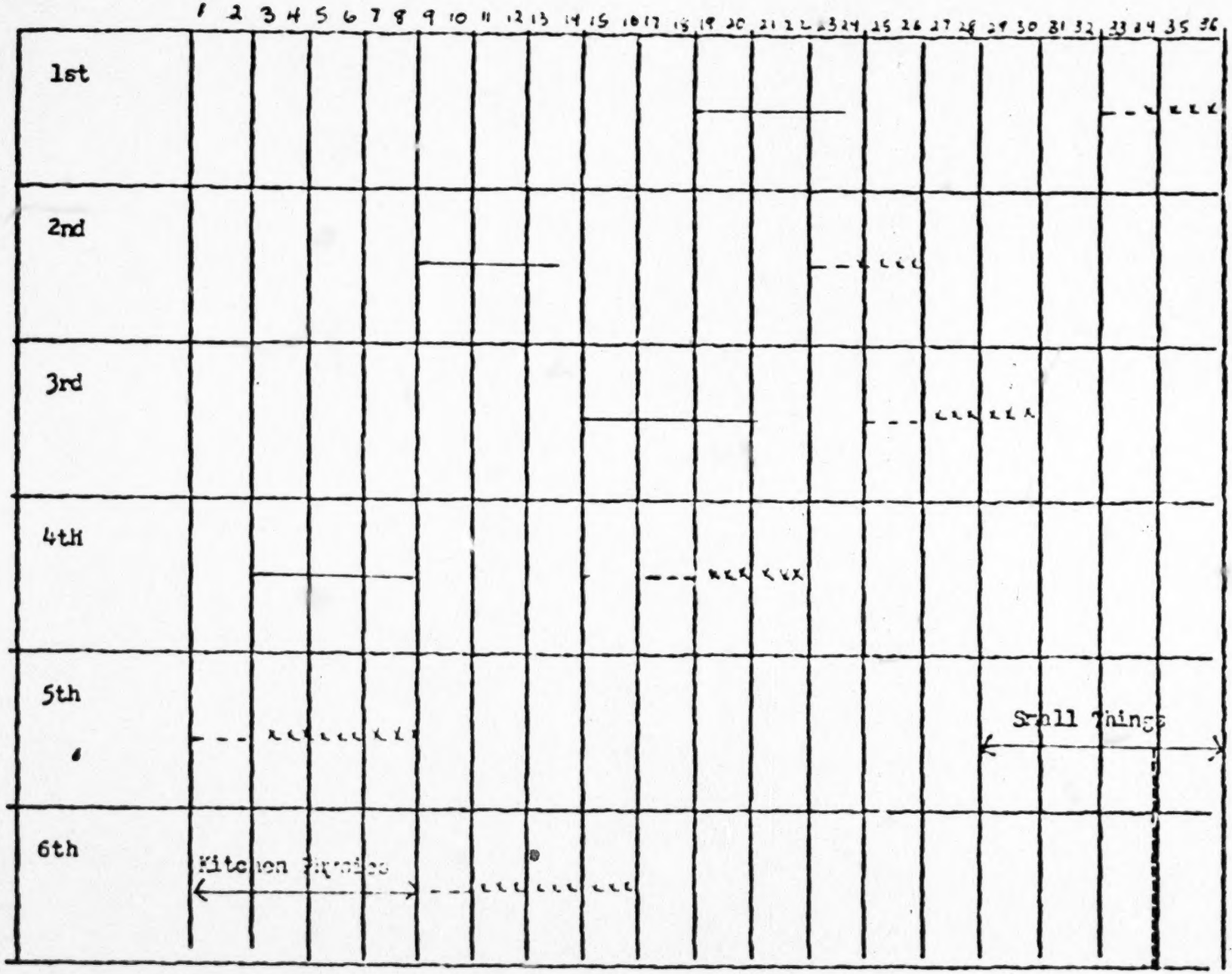
Charts outlining a three-year plan for the introduction of the 18 units follow.

Year I


Christmas
Spring Vacation
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
Grade I
9 Teachers
Grade II
8 Teachers
Grade III
8 Teachers
Grade IV
5 Teachers
Grade V
4 Teachers
Grade VI
4 Teachers

- - - Workshop preliminary to teaching

——— Classroom teaching with workshops continuing

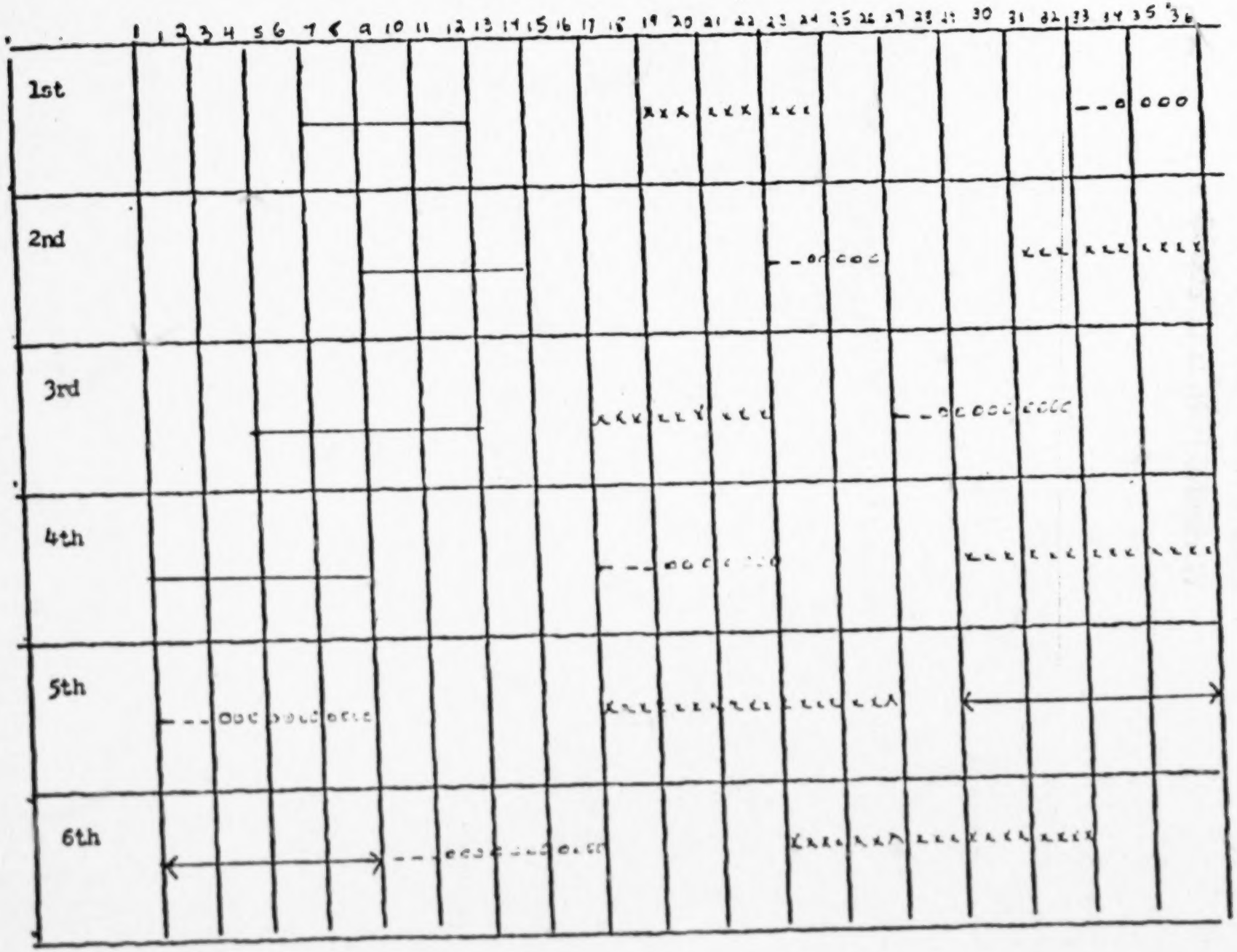


- - - -Pre-teaching workshops for new units

ΛΛΛΛ Teaching of new units with workshops continuing

——— Units introduced in Year I -- now handled by teacher independently and extended in scope

Year III



--- Pre-teaching workshop

oooo Teaching of new units with workshops running concurrently

____ Extended Year I Units